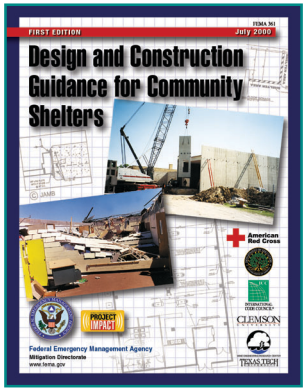
Tornado Profile

The National Weather Service defines a tornado as a violently rotating column of air pendant from a thunderstorm cloud that touches the ground.

From a local perspective, a tornado is the most destructive of all atmospheric-generated phenomena. In an average year, a little more than 800 tornadoes hit various parts of the United States, though the number has varied from 500 to 1,400 in a given year. More tornadoes are recorded in the months of May and June than in any other month (Figure 1-1). Figure 1-2 shows the geographic distribution of tornadoes in the United States.



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Determining Tornado Risk

Detailed guidance for determining the magnitude of the tornado risk in a specific area of the United States is presented in FEMA publication 361, *Design and Construction Guidance for Community Shelters* (for more information, see the section of this booklet titled **Information Sources**).

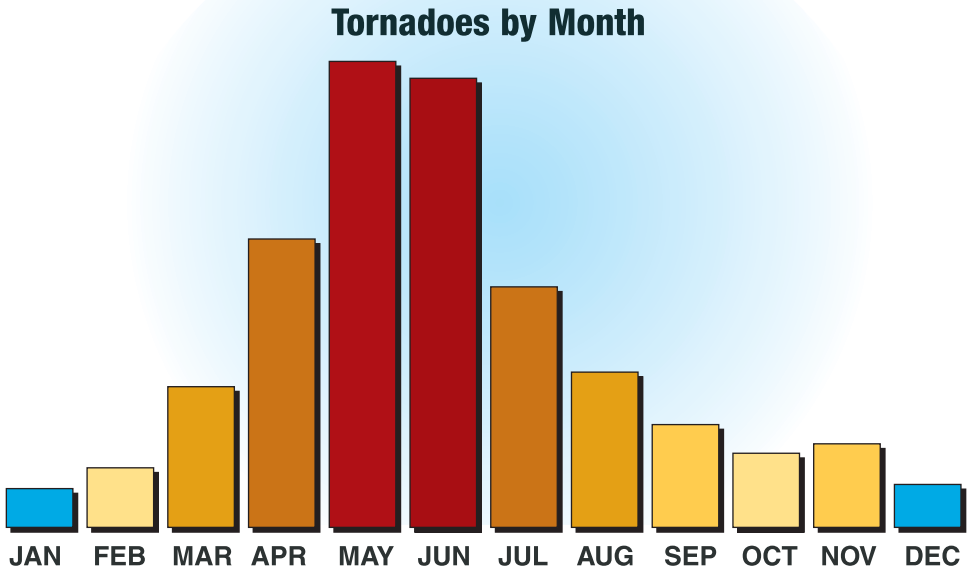

Figure 1-1 Tornado occurrence by month in the United States.

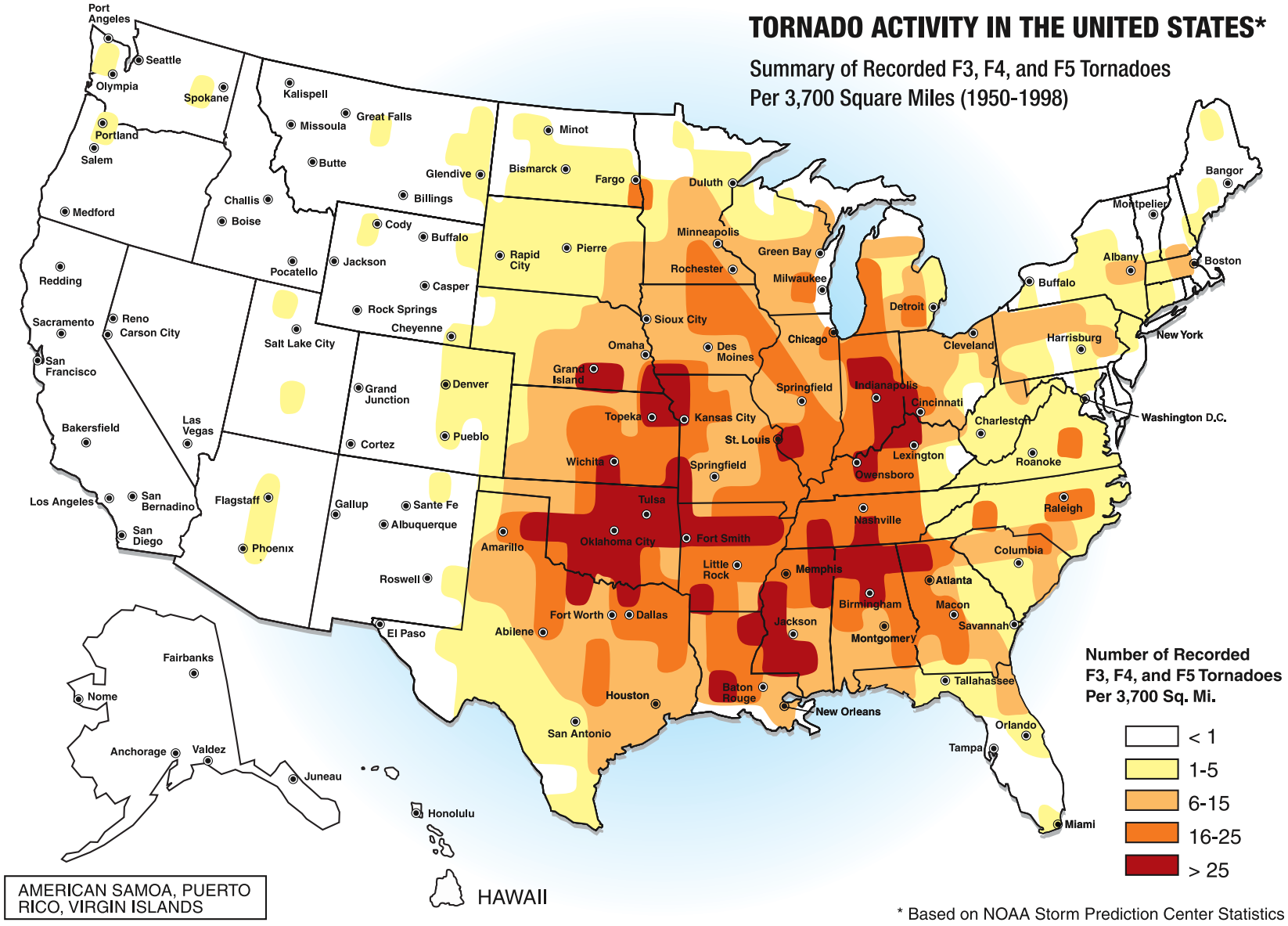

Figure 1-2 Tornado occurrence in the United States based on historical data.


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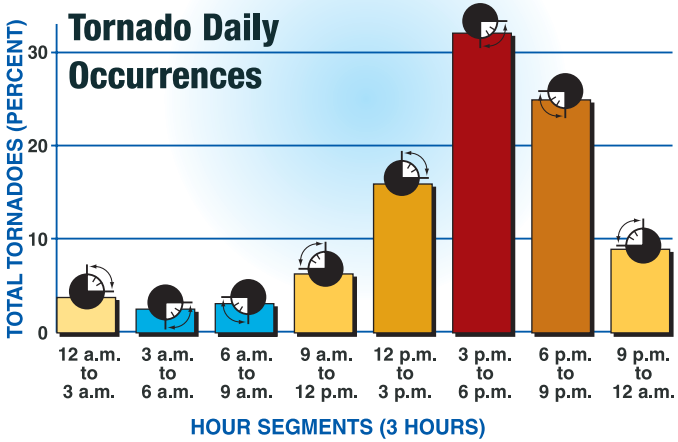

Figure 1-3 Tornado occurrence by time of day.

Tornado Characteristics

The **time of day** when tornadoes are most likely to occur is the mid-afternoon, between 3:00 p.m. and 6:00 p.m. (Figure 1-3). Occasionally, severe tornadoes have been recorded in the early morning or late evening.

The **direction of movement** is predominantly from the southwest to the northeast. However, tornadoes have been known to move in any direction along with the parent thunderstorms.

The **length of path** averages 5 miles, but some tornado paths have exceeded 100 miles.

The **width of path** averages 300 to 400 yards, but may reach up to 1 mile.

The **travel speed (translational)** averages 25 to 40 miles per hour (mph), but speeds from 5 to 60 mph have been recorded.

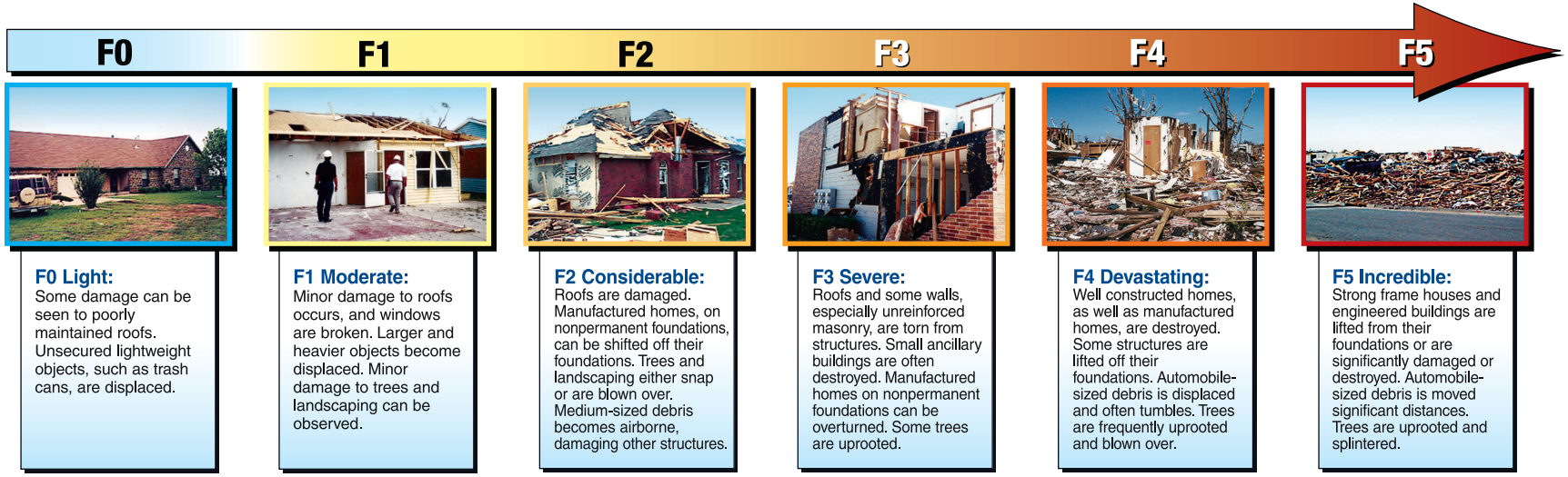

Figure 1-4 The Fujita Tornado Damage Scale.

The **rotational speed** is assumed to be symmetrical. The maximum rotational velocity occurs at the edge of the tornado core. The speed reduces rapidly as the distance from the edge increases.

The **intensity of damage** from a tornado is related to wind speed, windborne debris, and type of construction. The atmospheric pressure drop in the center of a tornado does not destroy buildings, because pressures inside and outside of buildings equalize through broken windows and doors or through openings that result when sections of the roof are removed.

Tornadoes are rated by the National Weather Service according to the tornado damage scale developed by Dr. Theodore Fujita, a professor of meteorology. Ratings vary from F0, for light damage, to F5, for total destruction of a building (Figure 1-4). Ninety percent of the tornadoes recorded over the past 45 years have been categorized as F0, F1, or F2 (Figure 1-5).

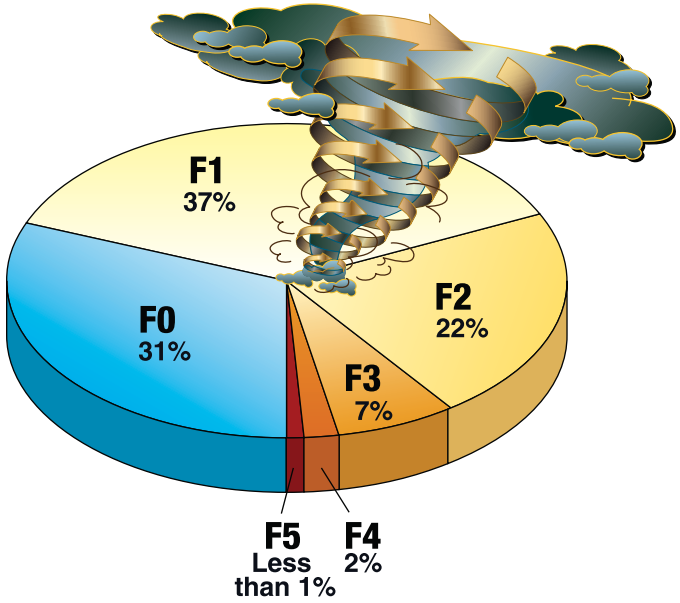

Figure 1-5
Percentage of recorded tornadoes by Fujita Tornado Damage Scale ranking.

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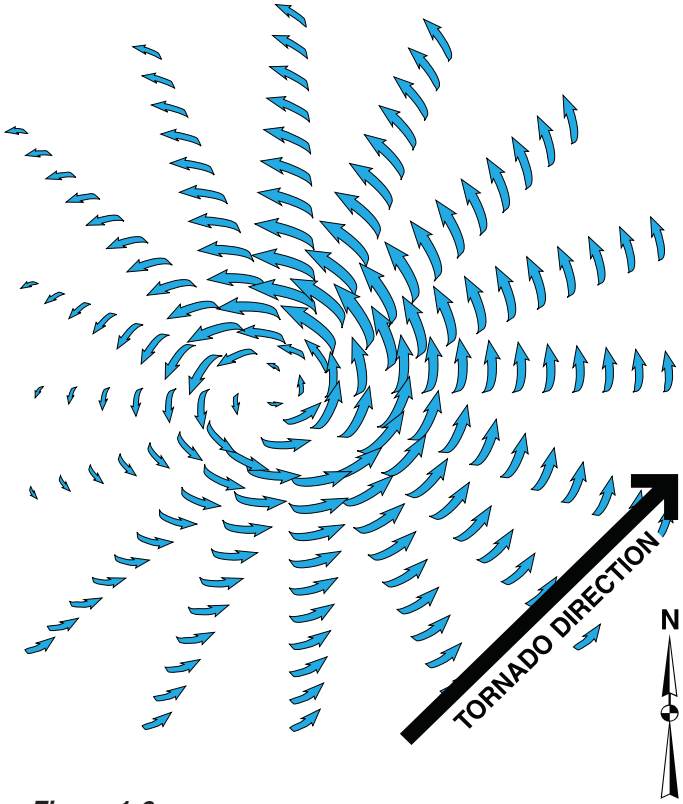

Figure 1-6
Typical tornado rotation.

Rotation is generally counterclockwise in the northern hemisphere (Figure 1-6). About 10 percent of tornadoes have been known to rotate clockwise.

Wind speed is the sum of rotational speed and translational speed. The rotational speed decreases as the distance from the center of a tornado increases. With a counterclockwise rotation, the wind speed on the right side of the tornado is higher because the translational speed adds to the rotational speed.

Because of the unpredictability of tornado paths and the destruction of commonly used instruments, direct measurements of wind speeds have not been made in tornadoes. Rather, wind speeds are judged from the intensity of damage to buildings. Engineering assessment of damage puts the maximum wind speed at 200 mph in most destructive tornadoes, and the speed is not likely to exceed 250 mph near ground level.